National Park Service
U.S. Department of the Interior

National Capital Region Network

NATIONAL CAPITAL REGION NETWORK DATA MANAGEMENT PLAN

EXECUTIVE SUMMARY

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Executive Summary

Collecting data on specific natural resource parameters is our first step toward understanding the ecosystems within our national parks. These ecosystems are evolving, as is our knowledge of them and how they work. We use these "raw" data to analyze, synthesize, and model aspects of ecosystems. In turn, we use our results and interpretations to make decisions about the Park's vital natural resources. Thus, *data* collected by researchers and maintained through sound data management practices will become *information* through analyses, syntheses, and modeling. This can only be achieved through the development of a modern information management infrastructure (e.g., staffing, hardware, software) and procedures to ensure that relevant natural resource data collected by NPS staff, cooperators, researchers, and others are entered, quality-checked, analyzed, reported, archived, documented, cataloged, and made available to others for management decision making, research, and education.

Data Management Mission

The mission of the NCRN Data Management Program is to support to the NCRN Inventory and Monitoring Program by promoting:

- Data quality – Ensure that appropriate quality assurance measures are taken during all phases of project development, data acquisition, data handling, summary and analysis, reporting, and archival.
- Security – Our objective is to make certain that both digital and analog forms of source data are maintained and archived in an environment that provides appropriate levels of access to project managers, technicians, decision makers, and others.
- Interpretability – Sufficient documentation should accompany each data set and any reports and summaries derived from it, so as to ensure that users will have an informed appreciation of its applicability and limitations.
- Availability – Our objective is to expand the availability of natural resource information by ensuring that the products of inventory and monitoring efforts are created, documented and maintained in a manner that is transparent to the potential users of these products.
- Longevity – The longevity of a data set can be enhanced by thorough documentation, by maintaining the data in a widely interpretable format, and by appropriate archival measures.

This document summarizes the NCRN data management strategy, which is more fully presented in the NCRN Data Management Plan (DMP; Sanders et al. 2005). The NCRN DMP serves as the overarching strategy for achieving the goals noted above. The plan supports I&M program goals and objectives by ensuring that program data are documented, secure, and remain accessible and useful indefinitely.

NCRN DATA MANAGEMENT STRATEGY

The NCRN data management strategy holds that all data and derived information generated or otherwise used by the program will meet a high level of quality standards. Further, all data and information the NCRN program deems necessary to meet its objectives, and that are not otherwise maintained, will be archived, documented, and made easily available and accessible. Data and information will be managed in a transparent manner such that all components

may be easily compared by location, time, and subject. Data and information will be accompanied by supporting documentation (metadata) that provide context, value, utility, and longevity, thereby facilitating broad understanding of NCRN program output to current and future end users.

Data Defined

The NCRN I&M Program works with data from various sources and defines different data types in this way:

Programmatic Data—*Data developed or acquired directly by the network as a result of inventory, monitoring, or other projects*. This category includes project-related protocols, reports, spatial data, and associated materials such as field notes and photographs. Also included in this category are collaborative efforts between the NCRN and other NPS or non-NPS entities.

Non-Programmatic Data—*Data developed by entities other than the I&M Program.* There are two types of non-programmatic data:

> NPS Data—*Data developed by other NPS entities.* The NCRN utilizes numerous datasets developed by parks (e.g., park based inventories or research, regional programs).
>
> Non-NPS Data—*Data acquired and/or maintained by non-NPS sources.* Datasets developed by other government agencies and/or non-government organizations. Examples of these data sources include air quality data from EPA, water quality data from county agencies, and remote sensing products such as satellite imagery and aerial photography.

DATA MANAGEMENT ROLES AND RESPONSIBILITIES

Collecting, analyzing and maintaining high quality data products require the combined efforts of numerous personnel. Therefore, proper data management standards must be understood and practiced by everyone involved in Network operations including regional staff, park staff and contractors and cooperators. Successful data stewardship requires that all Network personnel work together as a cohesive unit to ensure that data are collected using the appropriate methods and that all data sets are held to the highest quality standards. The table below lists the data stewardship roles and responsibilities of those involved in Network operation and data management.

CATEGORIES OF DATA STEWARDSHIP INVOLVING ALL NETWORK AND PARK PERSONNEL

Stewardship Category	Related Activities	Principal jobs or positions
Note: Each position is listed in only one category according to overriding responsibilities. However, most positions contribute in each category.		
Production	Creating data or information from any original or derived source. This includes recording locations, images, measurements, and observations in the field, digitizing source maps, keying in data from a hardcopy source, converting existing data sources, image processing, and preparing and delivering informative products, such as summary tables, maps, charts, and reports.	Project Crew Member Project Crew Leader Data/GIS Specialist or Technician
Analysis	Using data to predict, qualify, and quantify ecosystem elements, structure, and function as part of the effort to understand these components, address monitoring objectives, and inform park and ecosystem management.	Quantitative Ecologist Resource Specialist
Management	Preparing and executing policies, procedures, and activities that keep data and information resources organized, available, useful, compliant, and safe.	Data Manager Project Leader GIS Manager IT Specialist
End Use	Obtaining and applying available information to develop knowledge that contributes to understanding and managing park resources.	Monitoring Coordinator Park Managers and Superintendents Public and others

Although data management is a combined effort, the Network data manger is responsible for coordinating the Network's data management program to ensure that standards are met and guidelines adhered to in all Network activities. Achieving the high standards of data quality the data manager must work closely with Network project leaders. Project leaders are usually Network ecologists responsible for managing individual projects. They are tasked with ensuring that project data management meets the Network standards. Figure ES-1 illustrates some of the specific data management tasks involved with I&M projects and how the responsibility for those tasks is divided.

NETWORK INFRASTRUCTURE AND DATA MANAGEMENT ARCHITECTURE

The foundation of the NCRN data management program is composed of a combination of computer hardware connected over local and national networks as well as the applications, tools, and repositories run on these computer systems.

- *Infrastructure* – represents the computers and servers connected through computer networking services.
- *Architecture* – the applications, system tools, databases, and repositories that make up the program data management enterprise.

Our digital infrastructure has three main components: park-based local area networks (LAN), network data servers, and servers maintained at the national level. This infrastructure is maintained by park, regional, and national IT specialists, who administer all aspects of system security and backups.

The NCRN I&M Program relies heavily on regional and national IT personnel and resources to maintain the computer infrastructure as well as assistance in developing and augmenting the program's data management architecture. Therefore, communication with regional IT specialists is essential to ensure adequate resources and service continuity.

To achieve an integrated information management system, three of the national-level data management applications (NatureBib, NPSpecies, and NR-GIS Metadata Database) utilize application architecture with both desktop and internet-accessible (master) components (figure ES-2).

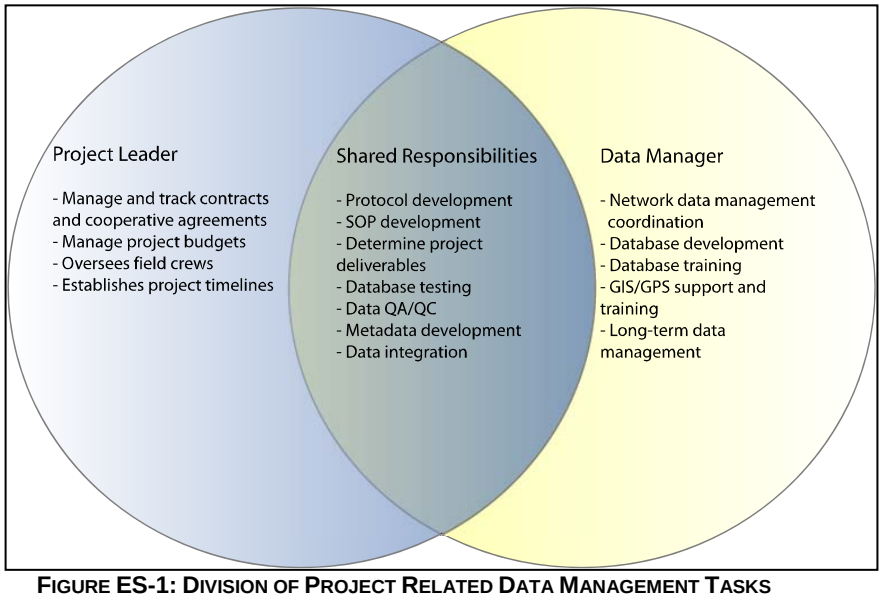

FIGURE ES-1: DIVISION OF PROJECT RELATED DATA MANAGEMENT TASKS
(adapted from the CAKN Data Management Plan)

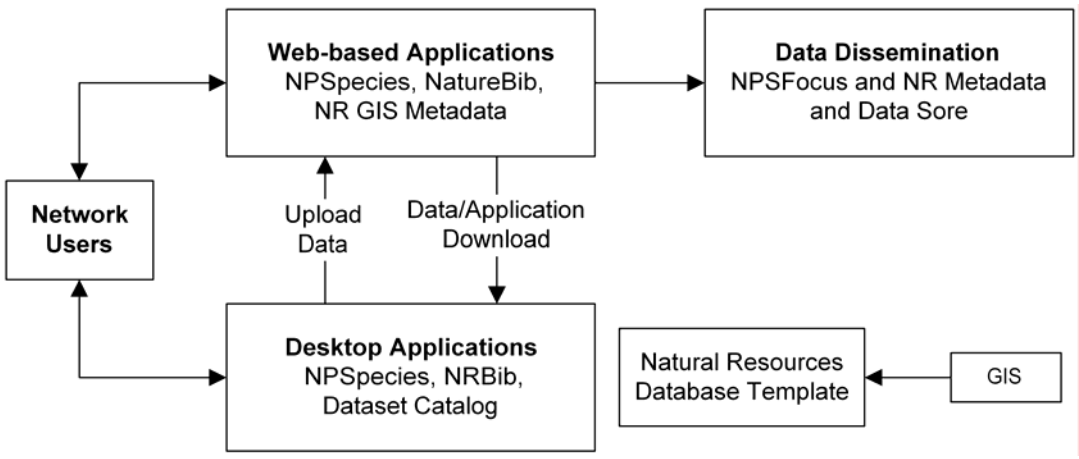

FIGURE ES-2: NATURAL RESOURCES DATABASE FRAMEWORK

An additional and integral component of the I&M data management infrastructure is the NPS STORET application for managing all data acquired during Network water quality monitoring. Water quality data collected as part of the network's monitoring program have distinct data management requirements. Data must be managed according to guidelines from the NPS Water Resources Division (WRD). This includes using the NPSTORET desktop database application at the parks to help manage data entry, documentation, and transfer to WRD. The NCRN will oversee the use of NPSTORET according to the network's integrated water quality monitoring protocol. Figure ES-3 illustrates the flow of information and data between the network, national program offices and EPA's main STORET repository.

Project Work Flow —All projects conducted by the NCRN have the same general workflow characteristics. Understanding the progressive stages of a project and the life cycle of the resulting data, we can more easily communicate the overall objectives and specific steps of the data management process. In addition, this awareness helps us to manage the staffing resources needed to produce, maintain, and deliver quality data and information. More details about data acquisition, quality assurance, documentation, dissemination and maintenance can be found in later chapters of this plan. Figure ES-4 illustrates the various project stages and highlights the data management tasks associated with each stage.

From the perspective of managing workflow, there are two main types of projects:

Short-term projects, which may include individual park research projects, inventories, or pilot work done in preparation for long-term monitoring.

Long-term projects, which will mainly be the implemented monitoring projects central to the I&M program, but which may also include multi-year research projects and monitoring performed by other agencies and cooperators. Long-term projects will often require a higher level of documentation, peer review and program support.

From a data management standpoint, a primary difference between short- and long-term projects is an increased need to adhere to standards for long-term projects to ensure internal compatibility over time. Both short-term and long-term projects share many workflow characteristics, and both generate data products that must be managed and made available.

DATA QUALITY ASSURANCE AND QUALITY CONTROL

Director's Order #11B states that all information (e.g., brochures, research and statistical reports, policy and regulatory information, and general reference information) distributed by the NPS (including information obtained from sources outside of the NPS) must be accurate, reliable and timely in nature. In order to disseminate accurate information, we must have confidence in the data we use. All data analyses, reports, and publications require data of

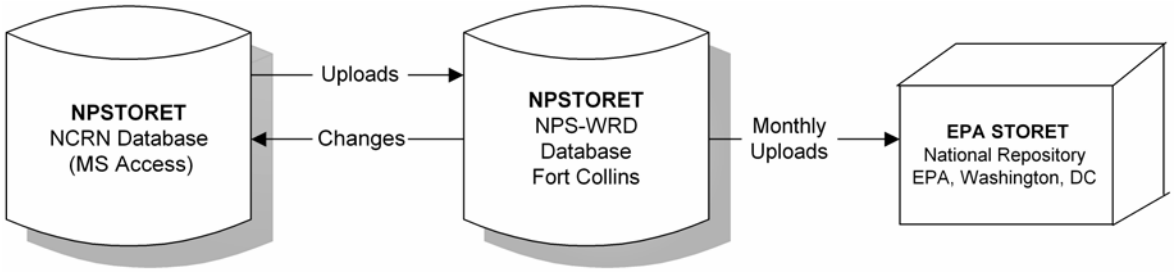

FIGURE ES-3: NATURAL RESOURCES DATABASE FRAMEWORK

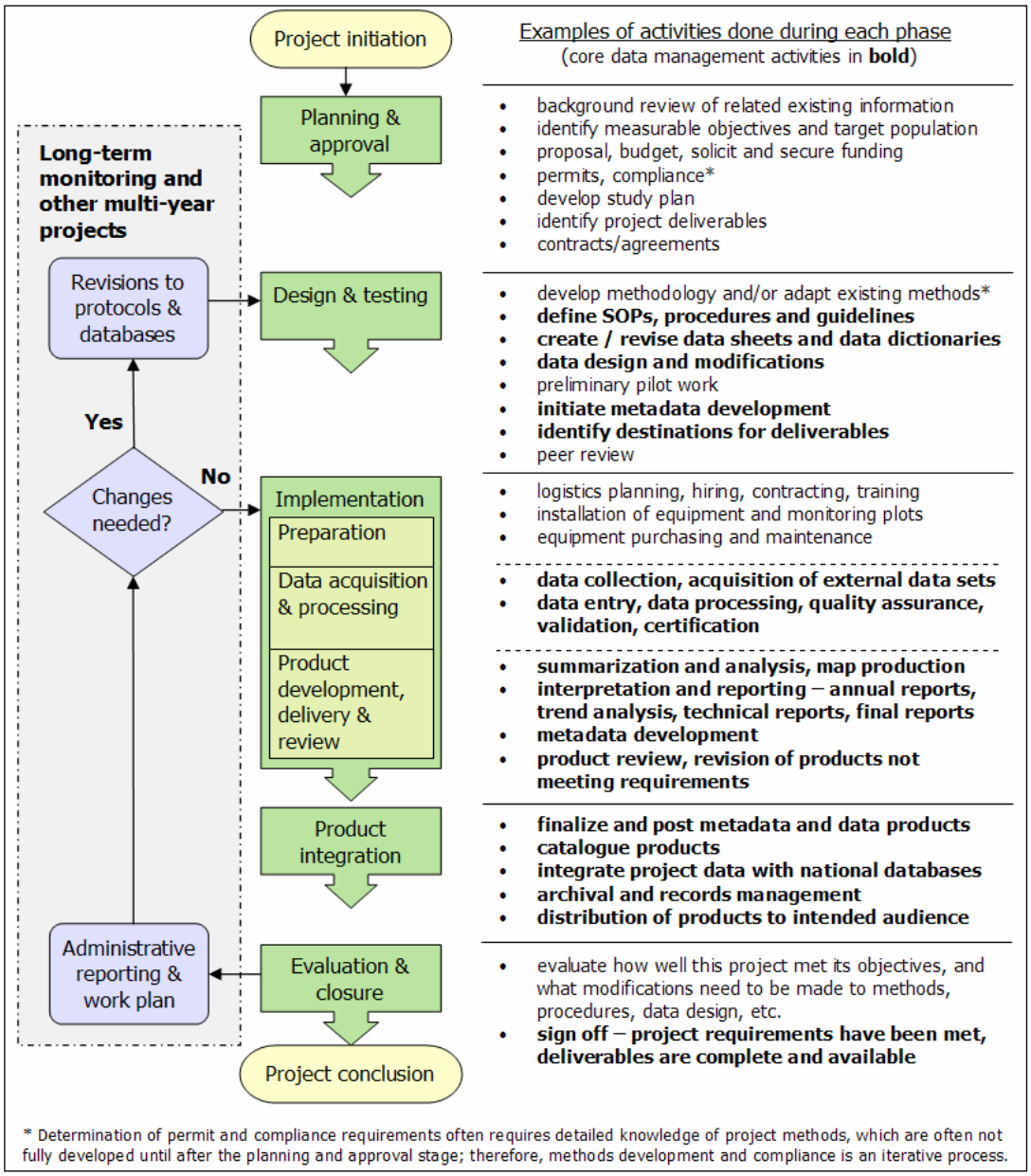

FIGURE ES-4: GENERAL STAGES OF PROJECT LIFE CYCLE

documented quality that minimize error and bias. Data of inconsistent or poor quality can result in incorrect interpretations and conclusions and improper management applications.

Palmer (2003) defines *Quality Assurance* (QA) as "an integrated system of management activities involving planning, implementation, documentation, assessment, reporting, and quality improvement to ensure that a process, item, or service is of the type and quality needed and expected by the consumer." He defines *Quality Control* (QC) as "a system of technical activities to measure the attributes and performance of a process, item, or service relative to defined standards." Quality Assurance procedures maintain quality throughout all stages of data development. Quality Control procedures monitor or evaluate the resulting data products.

QA/QC mechanisms are designed to prevent data contamination, which occurs when a process or event other than the one of interest affects the value of a variable and introduces two fundamental types of errors into a data set:

- *Errors of commission* — include those caused by data entry and transcription errors or malfunctioning equipment. They are common, fairly easy to identify, and can be effectively reduced upfront with appropriate QA mechanisms built into the data acquisition process, as well as QC procedures applied after the data have been acquired.

- *Errors of omission* — often include insufficient documentation of legitimate data values, which could affect the interpretation of those values. These errors may be harder to detect and correct, but many of these errors should be revealed by rigorous QC procedures.

We appraise data quality by applying verification and validation procedures as part of the quality control process. These procedures are more successful when preceded by effective quality assurance practices.

Data verification checks that the digitized data match the source data (i.e., does the database match the field data sheets?).

Data validation checks that the data make sense (e.g., is an ambient temperature reading of 120°F in the middle of winter really accurate?).

It is essential that we validate all data as truthful and do not misrepresent the circumstances and limitations of their collection. Failure to follow SOPs for data entry, validation, and verification will render a data set suspect. Although data entry and data verification can be handled by personnel who are less familiar with the data, validation requires in-depth knowledge about the data.

Communicating Data Quality — The Network will use data documentation and metadata to notify end users, project managers, and network management of data quality. A descriptive document for each data set/database will provide information on the specific QA/QC procedures applied and the results of the review. Descriptive documents or formal FGDC-compliant metadata will document quality for spatial and non-spatial data files posted on the Internet.

DATA DOCUMENTATION

Data documentation is a critical step toward ensuring that data sets are useable for their intended purposes well into the future. This involves the development of *metadata*. FGDC defines metadata as:

Metadata — information about the content, quality, condition and other characteristics of data.

Additionally, metadata provide the means to catalog datasets, within intranet and internet systems, thus making their respective datasets available to a broad range of potential data users.

Purpose of Metadata—Data sets sometimes take on lives of their own. Some seem to have the ability to reproduce and evolve on multiple hard drives, servers and other storage media. Others remain hidden in digital formats or in forgotten file drawers. In addition, once data are discovered, a potential data user is often left with little or no information regarding the quality, completeness, or manipulations performed on a particular "copy" of a dataset. Such ambiguity results in lost productivity as the user must invest time tracking information down, or, worst case scenario, renders

the dataset useless because answers to these and other critical questions cannot be found. As such, data documentation must include an upfront investment in planning and organization. Figure ES-5 illustrates the I&M Program's metadata system.

The importance for metadata is now universally accepted within the data management community. Recent legislative and policy efforts emphasize that data documentation must include and upfront investment in planning and organization.

Metadata Process/Workflow—The NCRN I&M Program deals with many different types of data sets from varying sources. The amount of documentation needed for different datasets may vary but the following is the basic steps to follow when documenting data sets.

Step 1. Identify Relevant Data Sets and Compile Pertinent Metadata

Step 2. Create Dataset Catalog Record

Step 3. Select Metadata Tool and Complete Record

Step 4. Make Information Available

DATA DISSEMINATION AND OWNERSHIP

The National Park Service defines conditions for the ownership and sharing of collections, data, and results based on research funded by the United States government. All cooperative and interagency agreements, as well as contracts, should include clear provisions for data ownership and sharing as defined by the National Park Service:

All data and materials collected or generated using National Park Service personnel and funds become the property of the National Park.

Any important findings from research and educational activities should be promptly submitted for publication. Authorship must accurately reflect the contributions of those involved.

Investigators must share collections, data, results, and supporting materials with other researchers whenever possible. In exceptional cases, where collections or data are sensitive or fragile, access may be limited.

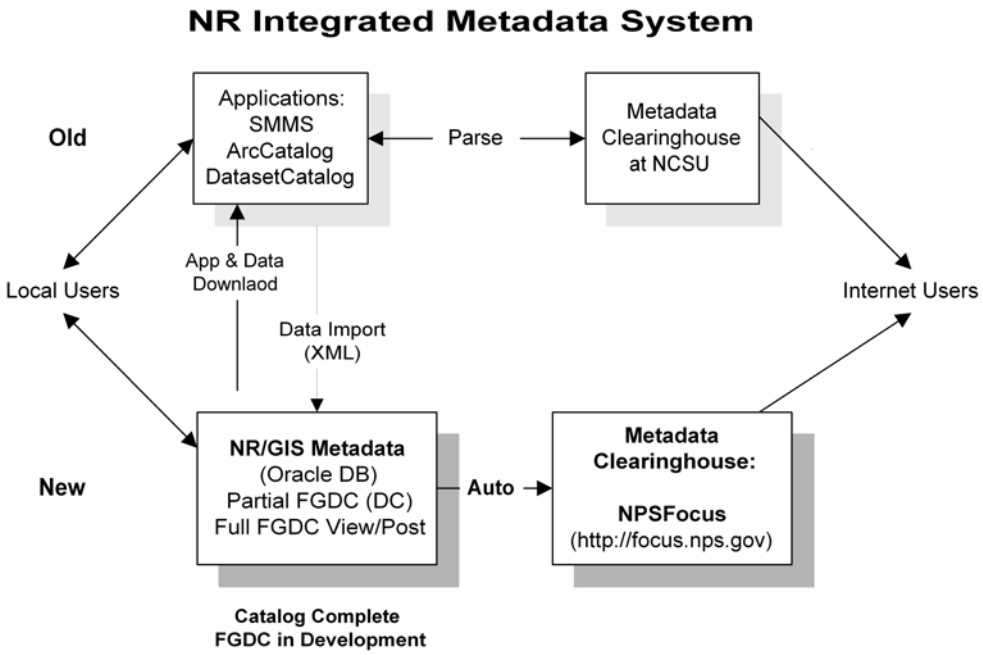

FIGURE ES-5: TAKEN AND MODIFIED FROM I&M DATA MANAGEMENT WORKSHOP, MARCH 2004

Data Classification: protected vs. public—All data and associated information from I&M activities must be assessed to determine their sensitivity. This includes, but is not limited to, reports, metadata, raw and manipulated spatial and non-spatial data, maps, etc. Network staff must carefully identify and manage any information that is considered sensitive. The Network must clearly identify and define those data needing access restrictions and those to make public.

The *Freedom of Information Act*, 5 U.S.C. § 552 (FOIA) stipulates that all US government agencies must provide access to data and information of interest, that are not protected from disclosure by exemptions, to the public. FOIA, as amended in 1996 to provide guidance for electronic information distribution, applies to records that are owned or controlled by a federal agency, regardless of whether or not the federal government created the records. Under the terms of FOIA, agencies must make non-protected records available for inspection and copying in public reading rooms and/or the Internet. Other records however, are provided in response to specific requests through a specified process. The Department of the Interior's revised FOIA regulations and the Department's Freedom of Information Act Handbook can be accessed at http://www.doi.gov/foia/ for further information. Network staff should consult their Regional FOIA Coordinator for more specific guidance whenever a particular instance of sharing information has the potential to involve protected information.

For example, information may be withheld regarding the nature and/or specific locations of the following resources recognized as 'sensitive' by the National Park Service. According to NPOMA, if the NPS determines that disclosure of information would be harmful, information may be withheld concerning the nature and specific location of:

- Endangered, threatened, rare or commercially valuable National Park System Resources (species and habitats)
- Mineral or paleontological objects
- Objects of cultural patrimony
- Significant caves

DATA MAINTENANCE

Data, documents, and anything that results from projects and activities that use Network data are all crucial pieces of information (figure ES-6). To ensure high-quality, long-term management and maintenance both digital and hard copy materials it is necessary to establish procedures that will permit a broad range of ers to easily obtain, share, and properly interpret both active and archived information while, at the same time, keeping the information secure.

Digital Data

In general, digital data maintained for lengthy periods of time will be one of two types: short-term data sets, for which data collection and modification have been completed (i.e., inventory projects); and long-term monitoring data sets, for which data acquisition and entry will continue indefinitely.

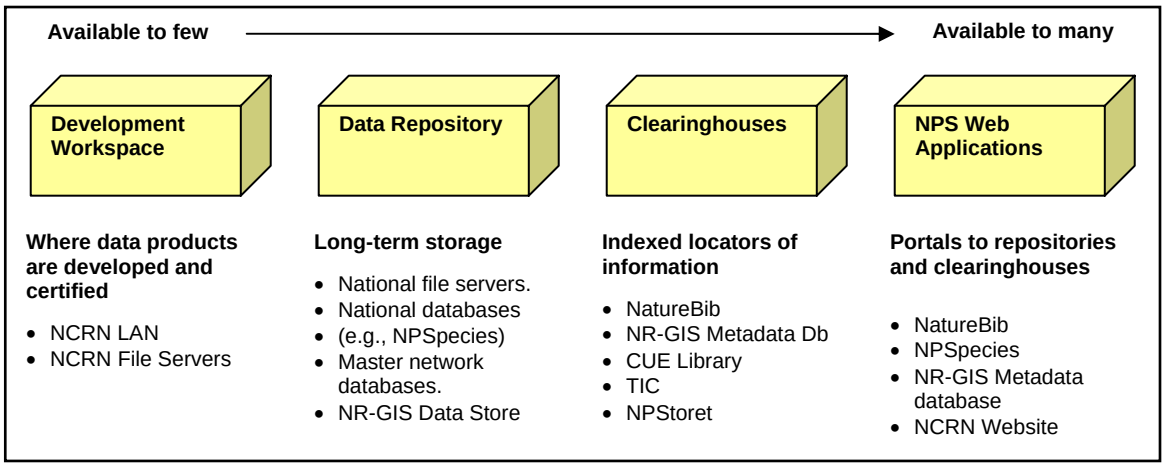

FIGURE ES-6: DATA DISTRIBUTION AND MAINTENANCE

Digital data will need to be stored in a repository that ensures both security and ready access to the data in perpetuity. All digital data sets are maintained on the NCRN file server under one of two directories depending on the depending on the status of the file.

Active Directory — used to house any file that is still in use or not yet considered complete. This includes datasets that have not yet undergone all of the necessary QA/QC procedures as well as draft documents.

Archive Directory — this directory contains all data sets that are complete (this mostly pertains to short-term projects such as inventories) along with completed reports, contracts and agreements. In the case of long-term monitoring data sets, because they will remain active indefinitely, the datasets will be archived periodically once the data have undergone QA/QC to preserve interim datasets. For data security purposes, this directory will be formatted as 'Read Only' for all personnel except the Data Manager and the Regional IT server support staff.

Digital Data Backup—The risk of data loss can come from a variety of sources, including catastrophic events (e.g., fire, flood), user error, hardware failure, software failure or corruption, and security breaches and vandalism. Performing regular backups of data and arranging for off-site storage of backup sets are the most important safeguards against data loss.

The NCRN I&M Program shares its file server with the National Capital Region Natural Resources and Science staff at the Center for Urban Ecology (CUE). Accordingly, backup procedures must be able to accommodate not only data produced by the I&M Program but all of the data and information stored by the regional staff as well. Due to the number of users utilizing the file server, the quantity of data included in the backup procedure quite large and constantly increasing.

Currently the NCRN backup plan calls for a complete daily backup of both the local directories and the shared directories (save two) that will enable a complete restoration of the file server for a period of thirty days. The two directories not included in the daily backup scheme are the GIS directory and the I&M Archive as the information in these directories changes infrequently. Data backups for these directories will take place once a week on a separate schedule.

Hard Copy Materials

The guidelines in this section apply to documents such as final reports prepared by staff or contractors, program administrative documents, contracts and agreements, memoranda of agreement, and other documents related to NCRN administration, activities and projects. These guidelines also apply to physical items such as natural history specimens, photographs, or audiotapes. In most instances, these documents and objects are essential companions to the digital data archives described earlier.

Documents—All paper documents managed or produced by the NCRN will be housed in one of two primary locations.

1. *NCRN central files*.
   The central files are maintained by the NCRN staff, at the Center for Urban Ecology. The NCRN will use acid-free paper and folders for all permanent records in the central files and store the documents in fire proof filing cabinets.

2. *Museum Resources Center (MARS)*
   MARS provides temperature and humidity-controlled facilities, a professional archival staff, and meets all museum standards set by NPS. This repository will be used for original documents and associated materials produced by the network (e.g., photographs, field notes, permits) that are a high priority to maintain under archival conditions.

For all materials submitted to MARS, NCRN will provide essential cataloging information such as the scope of content, project purpose, and range of years, to facilitate ANCS+ record creation and accession. NCRN will also ensure that materials are presented using archival-quality materials (acid-free paper and folders, polypropylene or polyethylene slide pages).

Specimens—It is recommended that all specimens collected under the auspices of the NCRN be archived at the regional Museum Resources Center (MARS); however, parks with the

proper storage facilities reserve the right to maintain their specimens in house. The NCRN will provide Park curators with associated data required for cataloging each specimen. These data will be in comma-delimited format (.CSV) format for automated uploading into ANCS+.

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